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How To Provide Effective Pain Management After Cardiac Surgery In The Geriatric Patient

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Introduction

Of the over 500,000 adult cardiac surgeries performed in the United States yearly[1,2,3], 54% are performed on the elderly[4]. According to the World Health Organization (WHO)[5], in most developed countries an "elderly" or "older" person is someone over 65 years of age. The American College of Critical Care Medicine (ACCM) has indicated that 82% of cardiac patients report pain as the most common traumatic memory of their ICU stay[6]. These numbers demonstrate the magnitude of the problem, and one of the reasons why pain is now recognized as an important stressor in critical care settings[7]. Pain after cardiac surgery is often severe, and pain relief is often inadequate and considered a low-priority task by caregivers[8,9]. Patients who underwent cardiac surgery often state they had no idea they would suffer so much postoperative pain and the lack of information provided to patients before surgery has been documented as contributing to higher postoperative pain levels[7,10]. Additionally, the lack of effective postoperative pain management impedes early mobilization and sufficient sleep, leads to postoperative complications and higher costs, and contributes to a longer length of hospital stay[9].

The fact that over half of cardiac surgery patients are elderly presents a unique challenge vis-à-vis their pain management after surgery. Geriatric patients run an increased risk for adverse side effects from pain medications compared to younger patients for several reasons[11]. Developing best practice guidelines to provide effective pain management after cardiac surgery in the geriatric patient is necessary to provide effective care. Three best practice guidelines focused on registered nurses and prescribing clinicians caring for this patient population in the acute care setting will be discussed: preoperative pain assessment of the geriatric patient, postoperative pain assessment tools for the geriatric patient, and pharmacological pain therapies.

It has been well documented that pain after cardiac surgery is often severe[12], undertreated, and one of the main reasons for emergency department visits and/or readmission[13]. Uncontrolled pain and the ensuing complications are even more common in geriatric patients[14]. The results of the lack of effective pain management can be both severe and prolonged[13]. This may well lead to negative pulmonary, cardiac, gastrointestinal, musculoskeletal, endocrine, and psychological effects as demonstrated by atelectasis, pneumonia, tachycardia and increased oxygen consumption, muscle weakness and disuse, hyperglycemia, and depression. Inadequate pain treatment may lead to chronic intractable pain as well. The incidence of chronic pain after cardiac surgery varies between 21% and 55%[13].

"…[O]ptimal pain management is considered as one of the main features in benchmarking and grading the quality of care…"[15]. As a matter of fact, this type of evaluation of healthcare has become a standard. Hospitals now must maintain adequate Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, and these scores are tied to reimbursement from the Centers for Medicare and Medicaid Services (CMS)[17,18]. The CMS reimbursement structure provides a strong financial incentive for hospitals to strive to improve their HCAHPS scores[17,18,19]. Better pain management provides one of those opportunities.

Literature review

Pain has physiological consequences that may adversely affect recovery after cardiac surgery as the sympathetic response to pain adds to cardiac workload, increases oxygen consumption, and can compromise hemodynamic stability[15]. Very often, nurses assess a patient's pain at rest and treating pain levels assessed solely at rest may not be adequate because of the rapid upsurge of activities to prevent post-op complications (deep-vein thrombosis, atelectasis). Simultaneously, many healthcare providers prescribe the same treatment for every cardiac surgery

patient when patients should be treated as individuals, and every pain regimen should be individualized[20,21,22,23]. This is especially true for geriatric patients[11,21,22,23,24,25,26]. Some major reasons articulated by prescribing providers for their reluctance to prescribe adequate doses of narcotics are twofold. Firstly, many of them claim that the patient's hemodynamic status will be adversely affected (decreased systolic blood pressure). Secondly, they claim that the patient will become overly sedated resulting in decompensation of the patient's respiratory status[21]. In reality, evidence shows that opioids used to control post-surgical pain cause hypotension less than 5% of the time and respiratory depression less than 1% of the time[21].

Additional evidence shows that, regardless of the fact that pain has been considered the 5th vital sign for over a decade now[27,28], and despite advances in pain management, little or no progress has been made to improve postoperative pain management[29]. In 1990, Stolic and Mitchell showed that 63% of patients rated their pain as being moderate to severe[30]. Replication of the study in 2007 focused on patients after cardiac surgery and this time 77.4% of the patients recalled having pain. The replicated study validated that nothing had changed, as a group, patients had no improved pain relief over the 17-year period[7,31,32,33]. As healthcare professionals, we continue to perform poorly in providing our patients with adequate pain relief postoperative cardiac surgery. There are several issues preventing effective pain management after cardiac surgery: inadequate or inappropriate pain management protocols and guidelines, inappropriate pain management by nursing staff regardless of protocols and guidelines, and the patients' inability or unwillingness to communicate when pain relief is inadequate[32].

In recognition of this, the American College of Surgeons (ACS) and the American Geriatrics Society (AGS)[34] recently issued a joint guideline to address geriatric perioperative care, including best practice for postoperative pain management. When managing postoperative pain in

the geriatric patient, providers must be cognizant of the physiologic changes and comorbidities common in this patient population[11]. Geriatric patients run an increased risk for adverse side effects from pain medications compared to younger patients for several reasons. First, many older adults in the U.S. take an average of five prescription medications daily, increasing the risk of adverse drug reaction (ADR) by 50%[11]. Second, the physiological changes that are part of the aging process result in a decrease in metabolism hereby also increasing the risk of ADR[11]. Thirdly, many geriatric patients suffer from comorbidities, on one side putting them at greater risk for ADR related to pain management, and on the other side at greater risk for complications from inadequate pain management[11,22,35,36].

Besides inadequate pain relief for the postoperative cardiac surgery patient, insufficient pain relief also affects the direct patient caregiver. Caring for patients who are not receiving adequate pain control can be as distressing for the nurse as it is for the patient. This conflict or ethical dilemma causes moral distress for caregivers. Moral distress leads to decreased job satisfaction and increased turnover in staff and has a detrimental effect on the patient experience[37,38,39]. The American Nurses Association (ANA) and the American Association of Critical-Care Nurses (AACN) have acknowledged that creating a healthy work environment is crucial to ensure patient safety, enhance staff recruitment and retention, and maintain an organization's financial viability[40].

Adequate postoperative cardiac surgery pain relief and postoperative pain relief in general, are imperative. At the same time, it is equally crucial that pain management be individualized. Milgrom et al.[19] write,

> Pain management should be individualized according to self-reported pain levels during postoperative activities (p. 123). Research continues to indicate that many patients still experience moderate to severe postoperative pain despite the guidelines identifying pain control as a priority in

> patients' care. Therefore, evidence-based education for health care professionals on the phenomenon, assessment, and treatment of pain should be a priority. Effective pain assessment and management after cardiac surgery can be achieved through a collaborative process in implementing and advancing clinical practice guidelines that emphasize an individualized approach for alleviating postoperative pain (p. 124).

In the Netherlands, van Gulik et al.[15] came to a similar conclusion, that effective pain management needs to be individualized, that it should focus on "…the prevention of pain and intervention-related pain" (e.g. pain related to extubation, chest tube removal, etc.). In Sydney, Australia, another group of researchers pointed out that patients after cardiac and other surgeries are commonly put on a "*fast track*"[41] (i.e. early extubation, early ambulation) to prevent postoperative complications. In these patients, "The lower levels of sedation given to expedite this process lead to higher levels of recall in critical care, in particular, memories of pain"[32].

Several hospitals have been able to successfully implement postoperative cardiac surgery pain management guidelines and protocols. One example is a guideline that was developed at the Royal Columbian Hospital, New Westminster, British Columbia[42]. It was based on a wellness model and predicated on the World Health Organization's analgesic ladder. The pain management approach used was pro-active, low-tech, low-risk, well tolerated, cost-effective, simple, and feasible, and 95% of patients reported they had effective pain relief.

More recently, an updated version of the "Clinical Practice Guidelines for the Sustained Use of Sedatives and Analgesics in the Critically Ill Adult" was published in the *Journal of Critical Care Medicine*, providing "…a practical roadmap for developing evidence-based, best practice protocols for integrating the management of P[ain,] A[gitation,] and D[elirium] in critically ill patients…"[6]. With all the current best practice evidence, healthcare providers owe it to their patients to educate themselves and provide them with effective pain control not only after cardiac surgery, but surgery in general.

Effective pain control after cardiac surgery in our unprecedented rising geriatric population presents a unique challenge. The publication of *Optimal Perioperative Management of the Geriatric Patient: Best Practice Guidelines from ACS NSQIP®/American Geriatrics Society*[34] provides an opportunity for providers to safely alleviate pain and suffering in this high-risk population. The aging process involves many physiological changes but it is not a uniform or consistent process. There is much variability between individuals, underscoring the significance of making an individual assessment of each patient in the perioperative period[34,36,37,43] by each member of the healthcare team.

Besides suffering the consequences of physiological changes during the aging process, elder adults are also more stoic and less likely to report pain due to an increase in cognitive deficit and communication difficultie[26], all contributing to a challenging pain assessment. Cumulatively, these facts demonstrate the crucial importance of starting the surgical care of the geriatric patient with a comprehensive preoperative assessment and an individualized perioperative pain management plan.

Historically, pain management and critical care were separate fields of research until the late 1980's. Several things happened at that time. Bryan-Brown and colleagues (1986)[43] increased awareness of pain in the critical ill, and critical care nurses identified pain research as a high priority[27]. Conventionally, these patients received high doses of narcotics during anesthesia, and remained intubated and sedated for up to 24 hours. They remained in the intensive care unit (I.C.U.) for at least 48 hours and the average length of hospital stay was 8-13 days[44]. Currently, patients after cardiac surgery are quickly weaned from mechanical ventilation and mobilized as fast as possible, usually well within 24 hours after their surgery[41].

While several organizations[6,23,45,46] have published clinical practice guidelines and/or protocols, or have implemented programs to address pain in the critically ill in general or in the postoperative cardiac surgery patient specifically[8], these guidelines are not widely followed yet. There is also a wide variety between healthcare institutions and the effectiveness of how pain after cardiac surgery is managed. Regardless of the significant scientific progress in the assessment and management of postoperative pain in the critically ill, little of that has come to fruition to actually benefit the critically ill patient[1,24], but some organizations have successfully addressed postoperative pain.

Hospitals in Belgium[47], Canada[42], and the Netherlands[15,16], revised their pain regimen making the nurse-driven multimodal treatment plans consisting of acetaminophen and morphine. In all of these examples, the patients showed a significant reduction in postoperative pain combined with a decrease in the amount of time to achieve an acceptable pain score (numeric rating <4).

In concurrence with the recommendations of their European and Canadian counterparts, the ACCM's multimodal postoperative pain management guidelines also acknowledge that it is safe and effective to use acetaminophen and NSAIDs in conjunction with opioids to manage postoperative pain in surgical ICU patients after major or cardiac surgery[6]. As others recommend[49,50,51], they also suggest the use of dexmedetomidine as an option for sedation in the critically ill as another opioid-sparing alternative to acetaminophen and NSAIDs.

Despite all the advances in and options for effective postoperative pain management, little or no improvement has been made in the level of pain that patients experience over the past 20 years[46]. To address this need, a multidisciplinary Surgical Pain Congress (SPC) was established in 2013. The SPC determined that, while the progression of acute pain to chronic pain is well

established, it is not widely appreciated[46]. The SPC also recommends a multimodal regimen for effective postoperative pain management similar to the ACCM's regimen. They take it a step further by recommending an aggressive procedure-specific and patient-specific multimodal approach. "What appears to be missing is an awareness of the need to improve surgical pain management, along with clear, specific and actionable guidance"[46]. Additionally, the American Society of Anesthesiologists Task Force on Acute Pain Management updated their *Practice guidelines for acute pain management in the perioperative setting* in 2012, honing in on acute pain management in the perioperative phase of care of all patients, including geriatric patients[23].

A review of the literature validates the need for effective postoperative pain management in all surgical patients and in cardiac surgical patients in particular. As mentioned before, more than half of cardiac surgery patients are geriatric patients. Three recommended best practice guidelines for providing effective pain management after cardiac surgery in the geriatric patient for registered nurses and prescribing clinicians caring for this patient population in the acute care setting will be discussed.

Methods

In order to address inadequate pain management in geriatric patients,

1. A comprehensive review of the literature using the key words pain management, pain control, postoperative and post-operative, heart surgery and cardiac surgery, geriatrics and elderly was conducted. The online bibliographic data bases used in the search are: Agency for Healthcare Research and Quality, SCOPUS, Ebscohost, PubMed, CINAHL and Google Scholar. National Clearing House was explored as well but there was no information relevant to the topic.

2. The 2015 *U.S. News & World Report, Health Care*[51] was used to identify the major cardiac surgery centers around the U.S. and the top ten were called, asking the same four questions.

3. The List Serve of the Advanced Nursing Practice in Acute and Critical Care (ANPACC) and the National Association of Clinical Nurse specialists (NACNS) were emailed requesting information on pain management in general and pain management after cardiac surgery in the geriatric patient specifically, but there was no response.

4. To validate the best practices and recommended pain management practice guidelines to be used after cardiac surgery in the geriatric patient via a review by experts in the field of pain management and cardio-thoracic surgery. Expert reviewers rated content on clarity and relevance and any recommendations were incorporated into the final product.

Best practice guidelines evaluated by experts

I. Preoperative pain assessment in the geriatric cardiac surgery patient: recommendation for best practice to provide effective postoperative pain relief.

While a preoperative assessment is essential for all patients, it is crucial in the geriatric patient. As described in the *Best Practice Guidelines from the American Geriatrics Society (ACS)* (2016)[34] a comprehensive preoperative assessment, including but not limited to a detailed pain assessment, in the geriatric patient undergoing cardiac surgery should be performed by the team member assigned to evaluate the patient preoperatively. The workflow is to include communication of pertinent findings with the patient's attending anesthesia provider. The assessment is to include, but should not be limited to a comprehensive perioperative assessment (see Table I), outlining patient demographics, physiologic state, nutrition and social variables[53,54]. Additionally, a comprehensive history of the geriatric patient's pain experience should be performed[34] (see Table II). In emergency geriatric cardiac surgery patients, a detailed assessment should be obtained from next of kin if and when appropriate, as soon as possible, asking the same questions as for the elective geriatric cardiac surgery patient.

II. Pain assessment tool for the postoperative geriatric cardiac surgery patient: recommendation for best practice to provide effective postoperative pain relief.

The pain assessment should include a thorough understanding of the documented comprehensive preoperative assessment and pain assessment by all healthcare professionals caring for the patient. There are many studies that have compared the different pain assessment tools currently available, in order to validate the most appropriate one for use in critically ill patients in general[7,55,56,57,58] and geriatric patients more specifically[58,59,60,61]. Based on the results of those studies, the Numeric

Pain Scale (NRS) and the Critical-Care Pain Observation Tool (CPOT) are the two pain scales of choice for the critically ill in general and for the geriatric critically ill patient population specifically as well[58,59,60,61]. Since geriatric patients account for over 50% of all intensive care unit days[60], it is crucial for critical care nurses to be prepared for properly assessing and managing pain in that population.

The Association of Critical-Care Nurses (AACN)[61] and the GPO[58] recommend the following guidelines for all critical care RNs.

1. For the patient who is able to self-report pain (cognitively intact): RNs should follow the AACN clinical practice guidelines[61] for expected practice and nursing actions, and they should have knowledge of recommendations by the GPO[58]. They include, but are not limited to: 1. Implementing a pain assessment policy using validated tools according to each patient's ability to communicate; 2. Appropriate patient teaching according to the situation at hand; 3. Routine performance and documentation of pain assessments. The AACN[61] and GPO[58] advocate using validated pain assessment tools or simple questions in patients who are able to self-report pain. They recommend teaching patients to use self-report pain scales and to use verbal and non-verbal communication. The recommended verbal communication pain scale tool is the NRS. The NRS involves asking a patient to rate his or her pain on a scale of 0 to 10, with 0 equal to no pain and 10 equal to the worst possible pain imaginable. Examples of non-verbal communication are pointing, head nodding and using a visual analog scale (VAS). This pain assessment scale (also referred to as Pain Thermometer Scale), consists of a line usually 10 cm long with the labels "no pain" and "worst pain" at opposite ends. Patients indicate their pain along the line and the distance between the "no pain" end and the mark provided by the patient provides a

measurement of the pain intensity score (see Table III. A). Several studies however, have shown that usefulness of the VAS in the immediate postoperative period has not been confirmed[62,63]. The AACN[61] and the GPO[58] further advise performing and documenting pain assessments routinely and at scheduled intervals, during activities and procedures known to be painful, and before and after pain medication administration.

2. For the patient who is unable to self-report pain (cognitively impaired): educate RNs about the AACN's[61] Practice Alert "Assessing Pain in the Critically Ill Adult,"[61] ensuring all RNs know what the expected practice and nursing actions are as promoted by the AACN[61]. Available at http://www.aacn.org/, Clinical Practice>Practice Alerts>Assessing Pain in the Critically Ill Adult - [8/2013]. It is recommended that all ICU RNs watch the AACN[61] free educational video (also available from the same site) to learn more about using the CPOT in the ICU. The Critical-Care Pain Observation Tool (CPOT) is the pain assessment tool recommended by the AACN[61] for use in critical care, and can be used for intubated and non-intubated critical care patients (see Table III. B). Nurses provide a score from 0 to 2 based on 4 domains: facial expressions, movements, muscle tension, and ventilator compliance. The total score ranges from 0 (no pain) to 8 (most pain).
3. For the geriatric patient with dementia, the GPO[58] specifically recommends using the Pain Assessment Checklist for Seniors with Limited Ability to Communicate (PACSLAC) (see Table III. C)[64]. It is a pain assessment tool for use by the RN in older patients who are cognitively impaired or with a limited ability to communicate and is available at http://www.geriatricpain.org/Content/Assessment/Impaired/Documents/PACSLAC_Tool.pdf. The tool consists of a checklist based on behavioral observations made at specific time intervals. The presence or absence of the behavior is scored and that score is compared

with the previous score. According to the GPO[58] an increased score implies an increase in pain is likely and vice versa. The GPO[58] website also offers some educational videos on how to assess pain in their patient population.

III. Pharmacological pain management for postoperative cardiac surgery geriatric patients: current recommendations for best practice to provide effective postoperative pain relief.

It is crucial for clinicians to become well-versed in how to provide effective pain management in the geriatric patient population. Compared to other age groups they require surgery more often, making them more susceptible to experience pain due to the increased prevalence of co-morbidities. As a result, they are more likely to take more analgesics over longer periods of time, even though they are less likely to report pain. This compounds the risk for perioperative drug interactions in the geriatric surgical patient. Although advances have been made in pain evaluation tools, postoperative pain is frequently poorly assessed in patients who suffer communication or cognitive deficits, resulting in inadequate pain management. Since elderly patients are especially susceptible to opioids and their side-effects, a multimodal pain management strategy is recommended[26].

The most recent guidelines from the American Geriatric Society (AGS, 2016)[34] to address postoperative pain in the geriatric surgical patient include the following: the development of an analgesic plan **before** surgery. This plan should be age-appropriate, multi-modal, and opioid-sparing. It should also avoid potentially inappropriate analgesics and anxiolytics[65]. The risk of adverse drug reactions (ADR) when taking 5 or more medications (polypharmacy) daily is 50%, and the fact that older adults in the U.S. take, on average, 5 or more medications daily, places them at a high risk[11]. Compounding the risk are a decline in organ function (change in metabolism and clearance), drug sensitivity, frailty and pharmacokinetics[11] (loss of muscle mass changes the

volume of medication distribution). A general rule for managing surgical pain in the geriatric patient is "to start low and go slow."[11]

Clinicians are recommended to start pain management therapy with the smallest possible dose and titrate to effect while continuously assessing the patient for therapeutic and side-effect responses[66]. At the same time, clinicians should be aware that many elderly patients suffer from chronic pain and may be treated for their condition. The preoperative pain assessment will reveal which patients. It is extremely important for the clinician to be aware that, in the event a surgical intervention is required, these patients need to continue taking their regular dose on the day of surgery in addition to pain medications required to control their postoperative pain[11].

An excellent guideline and best practice for the clinician is to refer to the Beers List[67]. Developed in 1991 by Dr. Mark Beers, it is a list of medications considered to be inappropriate for the elderly[67]. The list has been updated four times and is intended to improve the care of patients 65 years and older – it also underscores the importance of an individualized treatment plan[64]. Besides specifying drugs that should be avoided in the elderly – except those in palliative and hospice care - the latest version of the Beers criteria focuses on medications that should be dose-adjusted depending on an individual's kidney function and drug-drug interactions[34] (see Table IV). Recommended pain management medications for geriatric patients and their dosing are listed in table V[68,69].

Conclusion

In addition to an individualized treatment plan, and "With the goals of optimizing analgesia and minimizing systemic adverse effects in older patients, multimodal analgesia is the best practice"[11,70]. Postoperative pain management is a worldwide issue for all patients in general but

for the geriatric patient in particular because of the compounded risk for ADR due to a decline in organ function, increased drug sensitivity, frailty and pharmacokinetics[11]. "The older patient's perioperative evaluation for any surgical procedure should be performed by a multidisciplinary team focused on optimal postoperative pain management, recovery, therapy, and long-term follow-up when indicated."[24] It is also recommended having a preemptive pain management protocol/guidelines in place[70] (i.e. procedure-related for chest tube removal, endo-tracheal suctioning, etc.). "The treatment of postoperative pain of the older adult patient is critically important to a good out come after surgery."[11]

Table I. Comprehensive preoperative assessment: assess variables – some as described by Dr. Zacharoff on painedu.org (2015)[52], additional variables as described by Foreman, Milisen & Fulmer (2010)[22].

Patient-level demographics	**Patient's physiologic status**	**Additional patient-level considerations**
Age	Hepatic function	Metabolic competition with other medications
Gender	Renal function	Serum protein levels
Ethnicity	Cardiac function	State of nutrition
Genetics	Pulmonary function	Alcohol/substance abuse history
Height/weight	Neurological function	
Allergy/side effect history	Endocrine, Hematological, and Immunological function	
Presence of co-existing medical conditions	Gastrointestinal function	
	Musculoskeletal and integumentary function	
	Volume of distribution	

Table II. Comprehensive history of the preoperative cardiac surgery geriatric patient's pain experience[34].

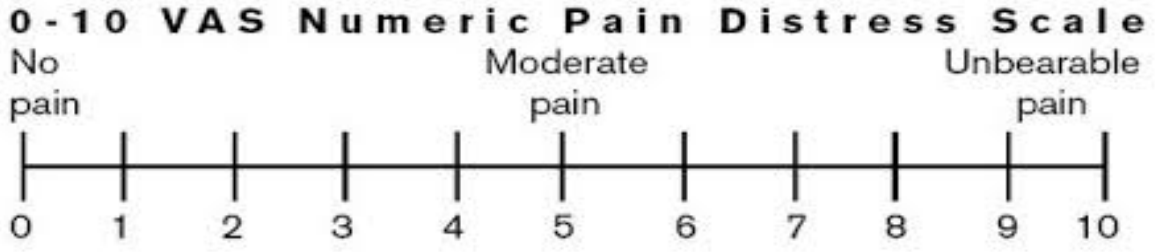
Assessment questions
What is the worst pain you have ever experienced?
Do you have any pain now?
Rate your current pain on a scale of 0-10 with 0=no pain and 10=worst pain you could ever imagine
Describe your pain in your own words (i.e. constant, intermittent, burning, cramping, etc.)
How often do you have pain i.e. constantly, intermittently, daily, at rest, with exercise, etc.?
Does your pain cause you to feel nervous or anxious?
If your pain causes you to feel nervous or anxious, then what to you do to decrease it or make it less?
What things do you do to relieve your pain: Medications or other things like meditation, music, heat/cold therapy, massage therapy, aromatherapy, guided imagery, acupuncture, etc.?
If answer = medications → what medications have worked in the past?
Have you ever had or do you currently have a problem with substance abuse
What number do you expect your pain to be after surgery?
On a scale from 0-10, what number would you rate your anxiety or nervousness?
Do you feel you would benefit from a light sedative pill for the night before your surgery?
Discuss goals for optimal postoperative pain relief with the patient and his family

Table III. Postoperative pain assessment tools as recommended by the American Association of Critical Care Nurses (2013) and the Geriatric Pain Organization (2015)[53,54,55,56,57,58,59,61,62,63].

A. Patients able to self-report

Numeric Rating Scale (NRS): "please rate your pain on a scale of 0 to 10 with 0=no pain and 10=the worst imaginable pain.

Visual Analog Scale (VAS) – see picture below. Please point to where your pain is on this scale



B. Patients unable to self-report or with limited ability to communicate

Critical Care Pain Observation Tool (CPOT) – see picture below.

Indicator	Description	Score	
Facial expression	No muscular tension observed	Relaxed, neutral	0
	Presence of frowning, brow lowering, orbit tightening, and levator contraction	Tense	1
	All of the above facial movements plus eyelid tightly closed	Grimacing	2
Body movements	Does not move at all (does not necessarily mean absence of pain)	Absence of movements	0
	Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements	Protection	1
	Pulling tube, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed	Restlessness	2
Muscle tension Evaluation by passive flexion and extension of upper extremities	No resistance to passive movements	Relaxed	0
	Resistance to passive movements	Tense, rigid	1
	Strong resistance to passive movements, inability to complete them	Very tense or rigid	2
Compliance with the ventilator (intubated patients)	Alarms not activated, easy ventilation	Tolerating ventilator or movement	0
	Alarms stop spontaneously	Coughing but tolerating	1
	Asynchrony: blocking ventilation, alarms frequently activated	Fighting ventilator	2
OR			
Vocalization (extubated patients)	Talking in normal tone or no sound	Talking in normal tone or no sound	0
	Sighing, moaning	Sighing, moaning	1
	Crying out, sobbing	Crying out, sobbing	2
Total, range			0-8

C. Pain Assessment Checklist for Seniors with Limited Ability to Communicate (APCSLAC)

Pain Assessment Checklist for Seniors with Limited Ability to Communicate (PACSLAC)

Indicate with a checkmark, which of the items on the PACSLAC occurred during the period of interest. Scoring the sub-scales is derived by counting the checkmarks in each column. To generate a total pain sum all sub-scale totals.

Facial Expression	Present
Grimacing	
Sad look	
Tighter Face	
Dirty Look	
Change in Eyes (Squinting, dull, bright, increased eye movements)	
Frowning	
Pain Expression	
Grim Face	
Clenching Teeth	
Wincing	
Open Mouth	
Creasing Forehead	
Screwing Up Nose	

Activity/Body Movement	Present
Fidgeting	
Pulling Away	
Flinching	
Restless	
Pacing	
Wandering	
Trying to Leave	
Refusing to Move	
Thrashing	
Decreased Activity	
Refusing Medications	
Moving Slow	
Impulsive Behaviours (Repeat Movements)	
Uncooperative/Resistance to care	
Guarding Sore Area	
Touching/Holding Sore Area	
Limping	
Clenching Fist	
Going into Fetal Position	
Stiff/Rigid	

Social/Personality/Mood	Present
Physical Aggression (e.g. pushing people and/or objects, scratching others, hitting others, striking, kicking).	
Verbal Aggression	
Not Wanting to be Touched	
Not Allowing People Near	
Angry/Mad	
Throwing Things	
Increased Confusion	
Anxious	
Upset	
Agitated	
Cranky/Irritable	
Frustrated	

Other (Physiological changes/Eating Sleeping Changes/Vocal Behaviors)	Present
Pale Face	
Flushed, Red Face	
Teary Eyed	
Sweating	
Shaking/Trembling	
Cold Clammy	
Changes in Sleep Routine (Please circle 1 or 2) 1) Decreased Sleep --- 2) Increased Sleep During the Day	
Changes in Appetite (Please circle 1 or 2) 1) Decreased Appetite --- 2) Increased Appetite	
Screaming/Yelling	
Calling Out (i.e. for help)	
Crying	
A Specific Sound of Vocalization For pain "ow," "ouch"	
Moaning and groaning	
Mumbling	
Grunting	
Total Checklist Score	

Table IV. Modified Beers List of common medications that may be prescribed for pain management in geriatric cardiac surgery patient[34, 64, 67].

Medication	Risk when used in the elderly	Recommendation
Central Nervous System:		
1. Benzodiazepines: *Short- and intermediate-acting. Alprazolam, estazolam, lorazepam, oxazepam, temazepam, triazolam	1. *Increased sensitivity and decreased metabolism of long-acting agents. Increased risk of cognitive impairment, delirium, falls, fractures and motor vehicle crashes.	1. Strong recommendation to avoid in the elderly
*Long-acting: clorazepate, clordiazepoxide, clonazepam, diazepam, flurazepam, quazepam	*May be appropriate for seizure disorders, REM sleep disorders, benzodiazepine withdrawal, alcohol withdrawal, severe anxiety, peri-procedural anesthesia	
Pain Medications:		
1. Meperidine	1. Safer alternatives available. Not effective if used orally, may have increased neurotoxicity (including delirium) than other opioids	1. Strong recommendation to avoid in the elderly, especially in those with chronic renal failure
2. Non-cyclooxygenase-selective NSAIDs, oral: aspirin >325 mg/d, diclofenac, diflunisal, etodolac, fenoprofen, ibuprofen, ketoprofen, meclofenamate, mefenamic acid, meloxicam, nabumetone, naproxen, oxaprozin,	2. Increased risk of GI bleed or PUD in high risk groups, including those >75 or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents. Reduced but not eliminated risk with use of proton-pump inhibitor (PPI) or	2. Strong recommendation to avoid chronic use unless other alternatives not effective and patient can take PPI or misoprostol.

piroxicam, sulindac, tolmetin.	misoprostol. Upper GI ulcers, gross bleeding or perforation due to NSAIDs in about 1% of patients treated for 3-6 mos, in 2-4% treated for 1 year. Correlation between % of sx and length of rx.	3. Strong recommendation to avoid in the elderly.
3. Indomethacin	3. More likely than other NSAIDs to have CNS effects. Most adverse effects of all NSAIDs	4. Strong recommendation to avoid in the elderly.
4. Ketorolac (includes parenteral)	4. Increased risk of GI bleed, PUD, and acute kidney injury.	5. Strong recommendation to avoid in the elderly.
5. Pentazocine	5. Severe CNS adverse effects including hallucinations and confusion. Safer alternatives available.	

Table V. Current medication and dosing recommendations for pain management in the geriatric cardiac surgery patient[68,69].

OPIOID ANTAGONISTS	**Renal Impairment & Hepatic Impairment Dosing**
Fentanyl *IV: 10-40 mcg IVP Q 2 hours PRN* Mild Pain (1-3): 10 mcg Moderate Pain (4-7): 20 mcg Severe Pain (8-10): 40 mcg	**Renal Impairment Dosing** *CrCl: 10-50 ml/min: decrease dose by 25% < 10 ml/min: decrease dose by 50% **Hepatic Impairment Dosing** No recommended adjustments provided by manufacturer
Hydromorphone *IV: 0.2-0.6 mg IVP Q 2 hours PRN* Mild Pain (1-3): 0.2 mg Moderate Pain (4-7): 0.4 mg Severe Pain: (8-10): 0.6 mg *PO: 2-4mg Q 3 hours PRN* Moderate Pain (4-7): 2mg Severe Pain (8-10): 4mg	**Renal Impairment Dosing** CrCl: <60 ml/min: decrease dose by 50-75% **Hepatic Impairment Dosing** Decrease dose by 50-75%
Morphine *IV: 1-4 mg IVP Q 2 hours PRN* Mild Pain (1-3): 1 mg Moderate Pain (4-7): 2 mg Severe Pain (8-10): 4 mg	**Renal Impairment Dosing** CrCl: 10-50 ml/min: decrease dose by 25% < 10 ml/min: decrease dose by 50% **Hepatic Impairment Dosing** Increase dosing interval to 3 to 4 hours
Hydrocodone/Acetaminophen (2.5mg/325mg) *PO: 1-2 tabs PO Q4-6 hours PRN* Moderate Pain (4-7): 1 tab Severe Pain (8-10): 2 tabs	**Renal Impairment Dosing** No recommended adjustments provided by manufacturer **Hepatic Impairment Dosing** Do not exceed 4gms/day of acetaminophen
Oxycodone/Acetaminophen (2.5/325mg) *PO: 1-2 tabs PO Q4-6 hours PRN* Moderate Pain (4-7): 1 tab Severe Pain (8-10): 2 tabs	**Renal Impairment Dosing** No recommended adjustments provided by manufacturer **Hepatic Impairment Dosing** Do not exceed 4gms/day of acetaminophen

NON-OPIOIDS	**Renal Impairment & Hepatic Impairment Dosing**
ACETAMINOPHEN *IV:* >50 Kg: *1000 mg IV Q 6 hours x 24 hrs* <50 Kg: *15 mg/Kg IVPB Q 5 hours x 24 hrs* PO: *650mg PO Q 4-6 hours x 48-72 hrs* Mild Pain (1-3)	**Renal Impairment Dosing** CrCl: 10-50 ml/min: use 6-hour dosing interval <10 ml/min: use 8-hour interval **Hepatic Impairment Dosing** Mild to moderate impairment: Do not exceed 4gms/day of acetaminophen Severe: Use is contraindicated
Dexmedetomidine IV: 0.2-0.7 mcg/kg/hour Do not use loading dose and titration should be no less than Q 30 minutes	**Renal Impairment Dosing** No recommended adjustments provided by manufacturer **Hepatic Impairment Dosing** Manufacturer recommends lower dosing in hepatic impairment
NEUROPATHIC PAIN MEDICATIONS	**Renal Impairment & Hepatic Impairment Dosing**
Carbamazepine *PO: 50-100 mg PO BID (with IV Opioids)*	**Renal Impairment Dosing** CrCl: <10 ml/min: 75% reduction **Hepatic Impairment Dosing** Manufacturer recommends to use with caution
Gabapentin *PO: 100 mg PO TID (with IV Opioids)*	**Renal Impairment Dosing** CrCl: 30-59 ml/min: use BID dosing interval <30 ml/min: use daily dosing interval **Hepatic Impairment Dosing** No recommended adjustments provided by manufacturer
Tramadol >75 y/o Moderate pain: 25 mg po q6 prn Severe pain: 50 mg po q6 prn 65-75 y/o Moderate pain: 50 mg po q6 prn Severe pain: 100 mg po q6 prn	**Renal Impairment Dosing** CrCl: <30 ml/min: q 12 hr dosing interval **Hepatic Impairment Dosing** Cirrhotics: 50 mg q12 prn

Pain Score: 0-10 numeric pain scale.
*CrCl: creatinine clearance measure by Cockroft-Gault Formula
Adapted from *Micromedex* (2016)[68] & *Lexicomp* (2016)[69].

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